Small Business Innovation Research/Small Business Tech Transfer

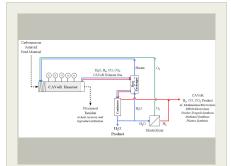
Carbonaceous Asteroid Volatile Recovery (CAVoR) system, Phase I



Completed Technology Project (2015 - 2015)

Project Introduction

The Carbonaceous Asteroid Volatile Recovery (CAVoR) system extracts water and volatile organic compounds for propellant production, life support consumables, and manufacturing from in-situ resources in support of advanced space exploration. The CAVoR thermally extracts ice and water bound to clays minerals, which is then combined with small amounts of oxygen to gasify organic matter contained in carbonaceous chondrite asteroids. In addition to water, CAVoR produces hydrogen, carbon monoxide, and carbon dioxide that comprise precursors to produce oxygen for propellant and breathing gas and to produce organic compounds including fuels and plastics. Additional CAVoR byproducts include nitrogen, sulfur, and phosphorus compounds that have potential uses as buffer gas for life support and reagents for more-advanced asteroid materials processing. Process residues are thermally stabilized by the CAVoR system, which renders them suitable as bulk shielding, as feed to mineral separation and concentration, or as raw material for manufacture of structural components. The CAVoR is a lowpressure, non-catalytic, batch process aimed toward maximum recovery of valuable constituents in a difficult operating environment using steel or other light-weight reactor alloys. Key elements of the CAVoR will be systematically developed and demonstrated through a progression from an Earth laboratory environment to experiments in zero-q flights and ISS with appropriate scale up and performance validations leading to implementation on a Near Earth Asteroid (NEA). Hardware designs to achieve required sealing and operating performance over long durations in microgravity will be derived in part from Pioneer's heritage in lunar and Mars ISRU. A combination of modeling and experimentation will be used to overcome the lack of current well-established state-of-the-art process methods and conditions for resource recovery from Near Farth Asteroids.



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Table of Contents

Project Introduction	1
Primary U.S. Work Locations	
and Key Partners	2
Project Transitions	2
Organizational Responsibility	2
Project Management	2
Images	3
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

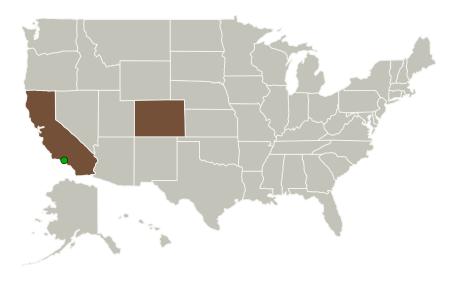


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Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Туре	Location
Pioneer Astronautics	Lead Organization	Industry Historically Underutilized Business Zones (HUBZones)	Lakewood, Colorado
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Colorado

Project Transitions



Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Pioneer Astronautics

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Mark Berggren

Co-Investigator:

Mark Berggren

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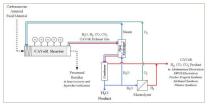
December 2015: Closed out

Closeout Summary: Carbonaceous Asteroid Volatile Recovery (CAVoR) system, Phase I Project Image

Closeout Documentation:

• Final Summary Chart Image(https://techport.nasa.gov/file/138734)

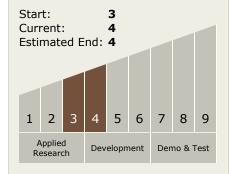
Images



Briefing Chart Image

Carbonaceous Asteroid Volatile Recovery (CAVoR) system, Phase I (https://techport.nasa.gov/imag e/133308)

Technology Maturity (TRL)



Technology Areas

Primary:

- TX07 Exploration Destination Systems
 - ☐ TX07.1 In-Situ Resource Utilization
 - └─ TX07.1.2 Resource Acquisition, Isolation, and Preparation

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System

